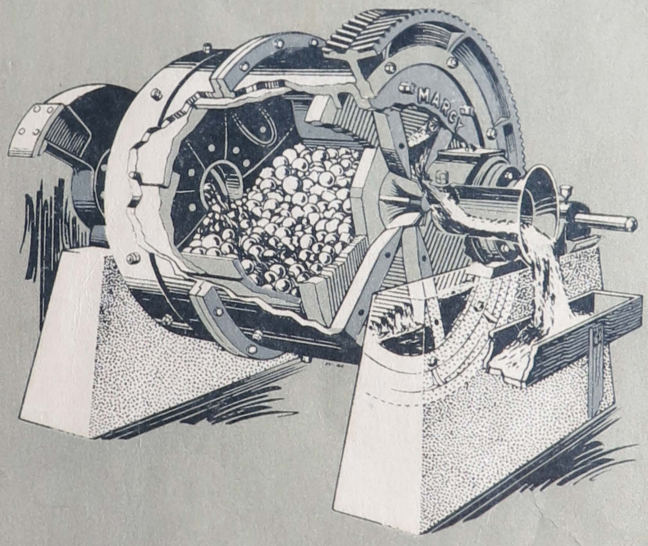
Catalog No. 42

MARCY MILL

A CRUSHER WITH CAPACITY



ONE EASY STEP

The MINE AND SMELTER SUPPLY COMPANY

DENVER :: SALT LAKE CITY :: EL PASO

New York Office, 42 Broadway

MARCY MILLS

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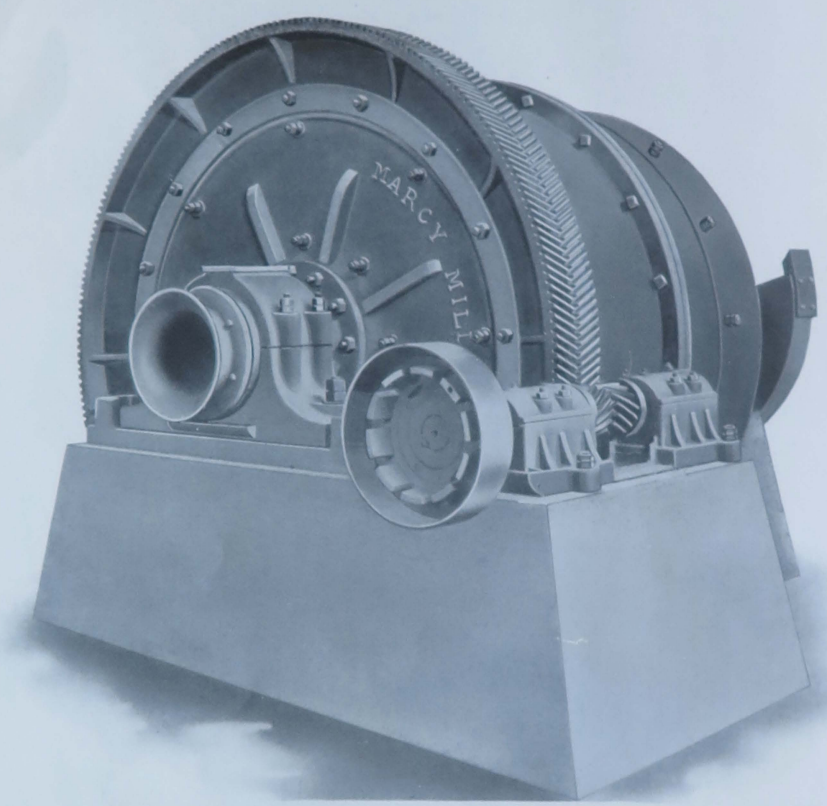
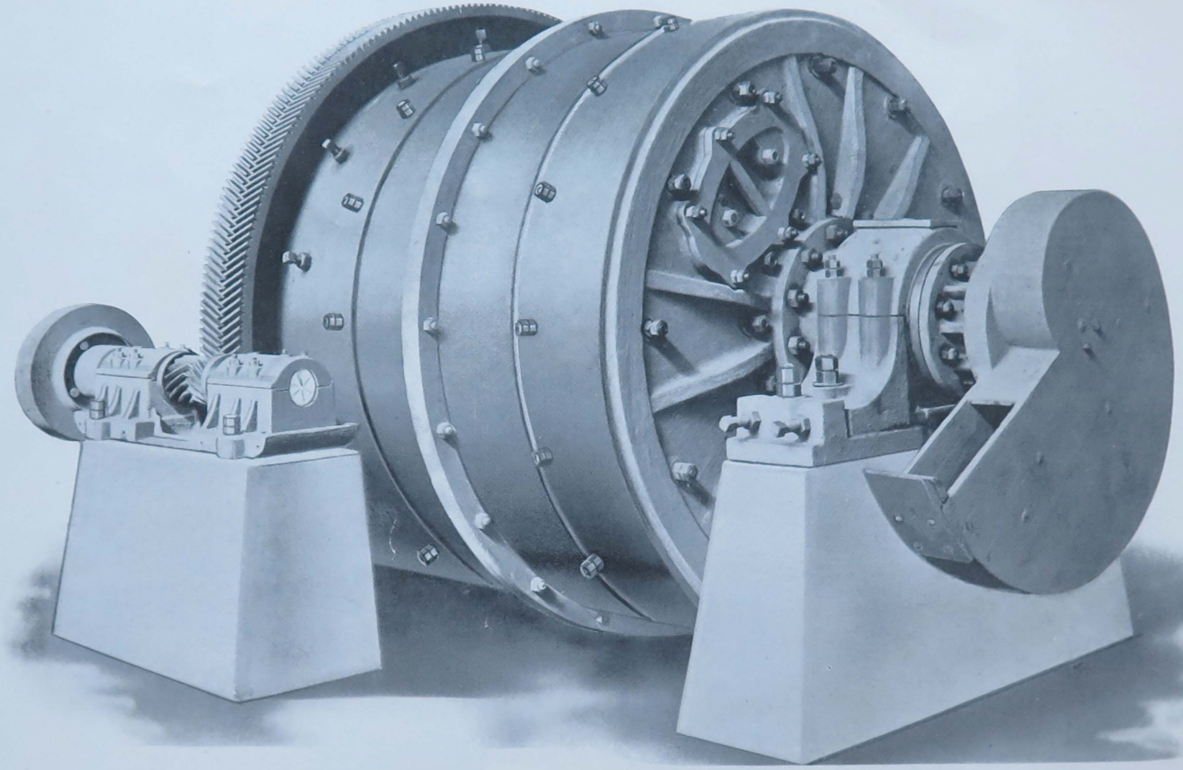
1918



Discharge End of Marcy Mill

"The length of the grinding mill has nothing to do with the fineness of the finished product when operated in closed circuit with a mechanical classifier. The classifier determines the size of the product made. The balls do not care whether they are in a short or long mill—rapid change of mill content is necessary for high efficiency."



Feed End of the Marcy Mill

A WORD

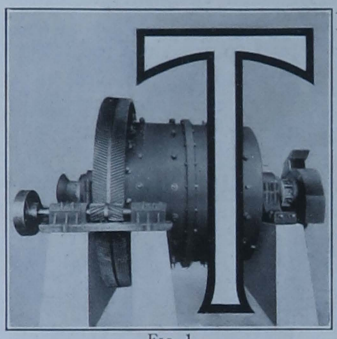


FIG. 1

THE Ball Mill, as perfected by F. E. Marcy, was the first to remove the impression held so long by metallurgists, that the Ball Mill is undesirable for the wet crushing of ores. The last three years have demonstrated the efficiency and correctness of Mr. Marcy's design. Crushing systems such as are found at Inspiration, Braden, Kennecott, etc., are unmistakable evidence that the use of the ball mill for the crushing of ores will soon be as general as in the cement industry, where it has been established for over fifty years.

Since 1915, when the Marcy Mill was introduced by us, hundreds have been manufactured and sold. These Marcy Mills are now crushing more than 60,000 tons daily, working under various conditions in many plants, and with satisfaction to their owners.

This improvement in ore crushing has made possible the further profitable reduction of much low grade ore for flotation hitherto beyond economical treatment, and has, in many instances, been the means of changing losses into profits. The progress made in mill construction during the past three years is proof that the art and practice of oil flotation has been materially advanced with the adoption of the Marcy Ball Mill.

Low first investments and simplicity of flow sheets in mill treatment plants are some of the results derived from this development, because a plant can be designed and successfully operated, consisting of a crusher, Marcy Mill, and concentrators or flotation machinery, eliminating rolls, elevators, screens, expensive buildings, etc. Users and purchasers of crushing machinery who are not already familiar with the Marcy Mill, should thoroughly investigate this "One Easy Step" system of crushing.

Not all ores, of course, are amenable to a single step crushing system; the metallurgy may demand a series of concentrating methods. The Marcy Mill will simplify most flow sheets. The mills may be operated in tandem if desired. They afford great flexibility when one considers that they are highly efficient in crushing all sizes of feed and that the finished product is under control, when the mill is operated in closed circuit with a screen, hydraulic or mechanical classifier. Remember that the length of the cylinder in this mill has nothing to do with the fineness of the product —it is determined by the classifier or screen.

GENERAL DESCRIPTION

FIG. 2

The Marcy Mill is a wet crushing ball mill having the entire discharge end fitted with a grate. Between the grate and the end of the mill there are arranged lifters which act as a pump to lift the product so it will be discharged through the trunnion of the mill. From outside appearance it looks like an ordinary overflow type of mill. The water enters the mill with the feed, and the feed enters the mill through the trunnion, consequently there is a difference in elevation between the feed as it enters the mill and the point of discharge through the grate. The water therefore causes a sluicing action which quickly carries the fines and slimes through the grate, then to the lifters and out through the trunnion or discharge end of the mill. This method of operation relieves the mill of a bulky mass of pulp and causes the fines to migrate faster than the coarse particles. It also increases the relative weight of the balls that would otherwise be under the influence of the buoyant effect of the pulp.

The product of the Marcy Mill is nearly non-selective. By non-selective is meant a product in which the mineral has not been subject to a classifying action, nor has it become over-crushed as compared with the gangue. Whereas, in the operation of all classes of overflow trunnion discharge ball mills, there is a vertical gravity classification of the mineral from the gangue. That is, the mineral being heavier, is carried lower or next to the periphery and consequently ground up into undesirable product. This fact has been pointed out by Professor Robert H. Richards in our first catalogue.

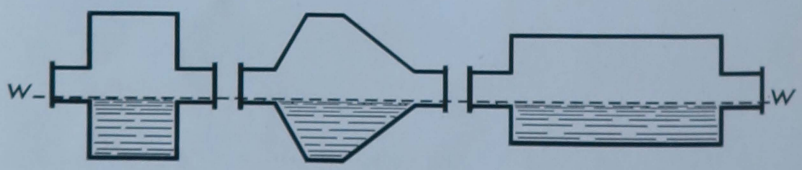


FIG. 3—TYPES OF OVERFLOW MILLS

Figure 3 represents different types of overflow mills; the feed enters at one end and the product overflows at the other. It makes no difference at which end the feed enters these mills, the product will be the same. This has been proven.

The line W-W shows the water level; on the lower side of this line there is a large amount of finished pulp, measured in tons, that is constantly being agitated by the continual falling or rolling of the balls without effect on the ore to be ground. On the other hand, this great volume of pulp reduces the relative gravity of the balls, it continually washes the balls of the gritty particles, retards the rapid circulation through the mill on account of the large volume contained therein, with the final result of reducing the capacity tremendously and lessening the efficiency of the mill itself.

In the practical operation of all overflow mills with a mixed charge of balls, the travel of the ore through the mill is accomplished by replacement. That is, the fresh material going into the mill replaces the ground material. There is practically no migration of fines over the coarse, other than that caused by the difference in gravity of the particles themselves. Again all sizes of material tends to be short-circuited by surface currents, or to remain in the center of the mill and be carried out, but in general there is no appreciable migration of the fines over the coarse. On the other hand, if the consistency is very thick, as 30% water, coarse ore will discharge freely, and in case of pebble mills the pebbles will be discharged from the mill.

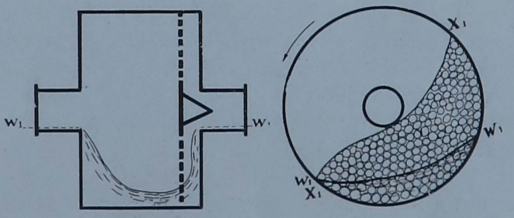
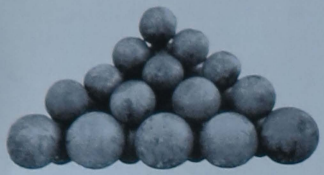


FIG. 4—SECTION MARCY MILL

Figure 4 represents the Marcy Mill with the low pulp line, with the discharge through the grate.

In this mill the pulp line is indicated by W^1-W^1, as compared with Figure 3, W-W, of a mill that is operating with overflow discharge. The basic principle can be understood by considering how easily a few grains of quartz can be crushed with a pestle and mortar, but how much more difficult it is to crush these when thrown into a tub full of slimy pulp. The Marcy Mill runs with small amount of pulp within it.

Applying this principle to the operation of Marcy Mills, we have:



1. Large balls will break large rock, but with the first blows many sizes are made including the finest of slimes. By removing the product as fast as made, you have graded crushing and gain in efficiency. This function is performed by the sluicing action of the water and the lifters back of the grates.

2. Marcy Mills are charged with many sizes of balls, and with the entrance of coarse feed to the mill it is soon a revolving mass, heavy, flexible and compact, in which all of the interstices are filled. Under these conditions, the maximum abrasion and crushing takes place. The voids between the balls are filled with the coarse ore which is essential for maximum efficiency; coarse sizes help to grind the finer sizes. This condition is maintained in this machine because it operates about $\frac{1}{3}$ or $\frac{1}{4}$ full of thick pulp, having a consistency of about 25% to 30% water. The liners, balls and the ore are covered with sand, thus, whenever there is a moving contact, crushing results.

3. The Marcy Mills, as stated, carry a small amount of pulp, which produces a rapid circulation, the more rapid the circulation in the mill, the greater the efficiency.

FEW MILL MEN appreciate or realize what it means in capacity or efficiency to have a mill that operates with relatively small amount of pulp within the mill. It means that the entire pulp content can be replaced quickly; therefore the circulation through the mill is very rapid. As an illustration, an ordinary short 8-ft. overflow mill will hold six tons of pulp. Let us say the rate of feed to the mill, including the water, is two tons per minute, then it would require three minutes to replace pulp within the mill with new pulp.

Whereas in the case of a Marcy Mill holding $1\frac{1}{2}$ tons of pulp, the rate of feed, including the water, being two tons per minute, only 45 seconds would be required to fill the mill to operating condition. In other words, the pulp completely changes four times faster in the Marcy than in the overflow type.

HOW DO WE KNOW that the Marcy Mill is more efficient than the overflow type?

(a) BECAUSE we have taken one of our large sized No. 86 Marcy Mills, removed the grates, and replaced them with solid liners, cemented up the lifters, and made an overflow mill of it, then compared it under parallel conditions with No. 86 Mill running along side of it fitted with grates and operated with a low pulp line. The mill with grates, or the patented Marcy Mill, had 80% more capacity, and 30% saving in power, over the same size mill overflowing through the trunnion.

(b) BECAUSE of the Inspiration test, a test where a direct and careful comparison was made costing thousands of dollars. This test has already been published, but a general summary is given.

INSPIRATION TEST

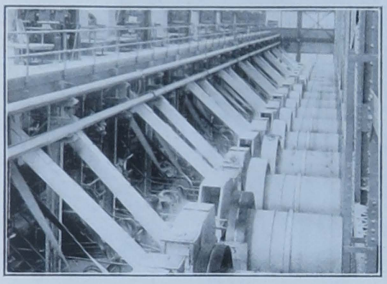


FIG. 5—MARCY MILLS

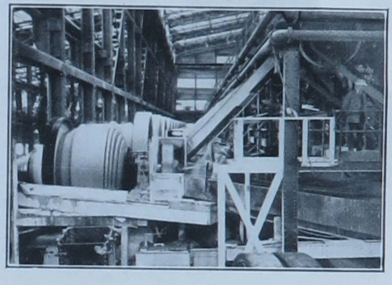


FIG. 6—CONE MILLS

On April 4th, 1917, two 8-ft. Cone Mills in one of the Sections at Inspiration Consolidated Copper Company were compared with a section of two 8-ft. Marcy Mills. The feed was taken from a common source. Both types of mill were operated in closed circuit with two 6-ft. Dorr Classifiers. The overflow from the Dorr was reduced to the same screen measure. The average results of the test showed: Apr. 4th to May 15th, 1917

Daily Dry Tonnage of the two Marcy Mills, 1,118 tons
Daily Dry Tonnage of the two Cone Mills, 485 tons
KW Hr. per ton crushed corrected 2% plus 48-mesh
Marcy Mills 8.52 Cone Mills 11.42

These tests were conducted to determine whether the Cone Mill could equal the Marcy, or substantiate the wonderful claims of the Manufacturer of the Cone Mills, and not to determine how much more efficient the Marcy Mill is proving itself.

First the tandem or step-crushing arrangement was tried with the Cone mills without satisfactory results; then each Cone mill was given coarse feed, but with no better effect.

Few mill men realize that the ball mill is in itself a graded crushing machine, and that it is particularly so in a mill where the contents empty quickly, as in the Marcy Mill. In this style of mill the balls exert their full crushing weight and are of many sizes, so meeting all conditions for the finest crushing.

We know that the greater the circulating load, the higher the crushing efficiency. The Cone Mills had the same classifiers as the Marcy Mills. The rakes with both types were fully loaded. The Marcy Mill had 130% greater capacity, consequently the Cone Mill, having the same size classifier, circulated the ore more than twice as often, but even with this advantage, the Marcy Mill saving in power was 34% of the Cone Mill.

The test proved that there was nothing gained in the tandem or stage crushing system, and it confirmed the company's original test and decision that the "One Easy Step" method of crushing was the proper choice for this plant. It was also a demonstration of the fact that Marcy Mills raised the tonnage from a doubtful 10,000 tons, if cone mills had been used, to 18,000 tons per day, with less cost per ton, and with remarkable profits to the Inspiration Copper Company. No other mills but Marcy Mills are used in this plant.

EVOLUTION IN MILLING

The Marcy Ball Mill was first introduced at the Utah Copper Company, then at the Magma Copper Company and Inspiration, where there was installed the largest tonnage Ball Milling Plant in the world, and which stands today the largest. After this installation followed Braden, Kennecott, Ray-Hercules, The United States Smelting and Refining Company, and many others.

The man who is responsible for the purchase of crushing and grinding machinery, and who is in the market, should remember that the evolution in ball mill crushing started with the Marcy Mill. After the Inspiration installation, other manufacturers endeavored to copy the Marcy Mill without leave or license from our company.

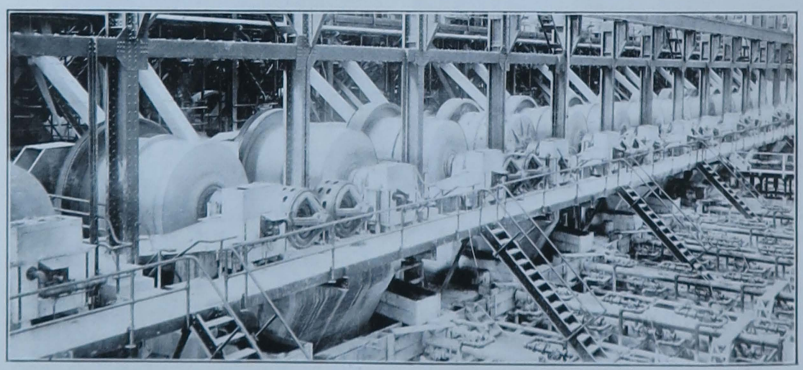


FIG. 7—LARGEST BALL MILLING PLANT IN THE WORLD

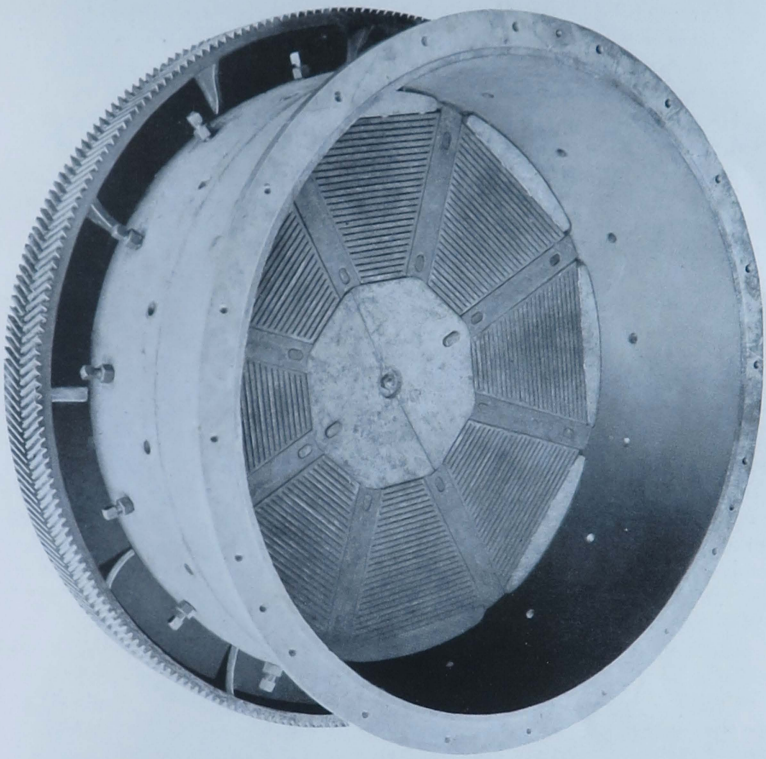


FIG. 8—DISCHARGE END OF MARCY MILL

There are many splendid features which make up the high efficiency of the Marcy Mill, but none of them is more important than the discharge end, which we have so successfully developed. There is no part more difficult to make and manufacture, and at the same time be satisfactory, than a good grate.

This discharge end is made up of special grizzly bars which are patented, and are made from high carbon tempered tool steel, carrying a certain percentage of chromium to insure high wearing qualities. These grates are tempered so that they will not upset. The bars are welded in sections and have their edges accurately machined to a taper, so that each section is securely held in place by the clamp bars, the bars themselves carrying very little taper, so that a minimum size of product is maintained throughout the life of the grate.

There is no single complicated part about these grates, and they need little or no attention from the time of installation until they are worn out.

The Marcy Mill discharge end has ten times the discharge opening through its grate that the ordinary ball mill has through its discharge trunnion.

The spacings of this grate are not radial, but are so arranged as to present a continuous opening to the discharging pulp, and on account of the length of slots, they are subject to washing action, which keeps them clean and free—they never blind or choke. In practical operation the pulp line can be raised or lowered by increasing or decreasing the amount of water, therefore the substantial and simple grate which we use meets this condition and is free from all mechanical devices or adjustments for raising or lowering the pulp line. The length of the Marcy Mill is less than the diameter. The capacity of the Marcy Mills is dependent more upon the diameter than the length. The big tonnages which are now being handled in the Marcy Mills are proof of its correct design and proportions.

OUR RECOMMENDATIONS

1st. WE RECOMMEND the Marcy Mill for crushing coarse ores, taking 3-inch to ½-inch feed and crushing it through 10-mesh by one pass of the mill, doing the work of rolls, trommels, elevators, etc. It has been found by actual experiment, after crushing thousands of tons extending over a long period of time, that the Marcy Mills have, in many cases, greater mesh-ton efficiency and lower cost per ton of dry ore crushed than rolls, also making a better product for concentration. Capacities of mill 25 to 1,000 tons per day, depending upon the size.

2nd. WE RECOMMEND the Marcy Mill for crushing coarse ores, taking a 3-inch to ½-inch feed and crushing it through 14-, 30- and 40-mesh. This mill to be operated in conjunction with a screen or hydraulic classifier for the return of over size. This product being especially desirable for concentration, leaching, amalgamation, etc. Capacities of mills, 25 to 600 tons per day, depending upon the size of the mill and product desired.

3rd. WE RECOMMEND the Marcy Mill for crushing coarse ores, taking a 3-inch to ½-inch feed and crushing it through 48-, 65- or 100-mesh when operating in conjunction with a mechanical classifier. The product may be used in all metallurgical processes, such as concentration, flotation, cyanidation, etc. Capacities of mills, 25 to 500 tons per day, depending upon size of the mill and product.

4th. WE RECOMMEND the Marcy Mill for regrinding jig middlings, tailings or similar products of ¼ to ⅜-inch or finer. The mill will reduce these products for concentration or flotation treatment when operating in conjunction with mechanical classifiers or screens with equal efficiency as when it is operated on coarse feed. The length of the grinding mill has nothing to do with the fineness of the finished product when operated in closed circuit with mechanical classifier. The classifier determines the size of the product made. The balls do not care whether they are in a short or long mill—rapid change of mill content is necessary for high efficiency.

OPERATING COST.—The cost of operation of the Marcy Ball Mill depends, of course, upon the character of the ore or the material to be crushed, the ultimate fineness, the cost of power, balls, lining and labor. Manganese steel or Chrome steel is generally used for liners, and the consumption is approximately from .2 to .5 of a pound per ton of ore ground. With Chrome steel balls and for coarse crushing, as 8-mesh, the consumption is from .3 to .7 pounds per ton of ore ground. When grinding in closed circuit with a mechanical classifier such as the Dorr, and crushing to minus-48-mesh, the ball consumption is about 1.7 pounds. (This is the Inspiration's figure.) Our Manganese Liners last from six to nine months and our grates from four to twelve months.

HOW MUCH WATER TO USE.—Where it is possible, we use about 30% water. If it is desirable to make a concentration product after it leaves the mill, a higher ratio of water should be used—as much as 50%, and in this way the gangue and the mineral particles have an equal chance to escape from the mill.

GENERAL INFORMATION

For the guidance of our customers, that they may intelligently discuss every problem with our Engineering Department, who are equipped to advise on most wet crushing ball mill problems, we suggest the following definitions:

TONS TO BE TREATED.—This should represent the dry tons to be crushed in 24 hours, taken from the bin or source of supply.

CIRCULATING LOAD is the part of the load that makes the entire trip or cycle through the mill and classifier or screen, and back to the mill, and should be stated in terms of percentage of the original ore, or tons to be treated.

INPUT TO MILL.—The input load is the amount of dry ore that enters the mill and generally is made up of the Tons To Be Treated plus the Circulating Load, and should be stated in tons per hour or in terms of percentage of the Tons to be Treated, or original ore.

CONSISTENCY is the ratio of the ore by weight as compared with the amount of water by weight. A ratio of two to one would mean that there were two parts of water by weight compared with one part of ore by weight. We prefer to use the word "consistency" rather than "density," the latter referring to specific gravity.

BALL CONSUMPTION is the loss of steel measured in pounds for each Ton to be Treated. Ball consumption should not be based on Input Load—a figure which some use; it is misleading.

BALL LOAD is the pounds or tons of balls contained within the mill.

MILL CONTENT represents the amount of pulp in tons contained within the mill when operating under normal conditions. The rate at which the content is changed is very rapid in the Marcy Mills on account of the low pulp line, as compared with the overflow type.

FINISHED PRODUCT is the product that is finished and is ready for the next metallurgical treatment. In one pass crushing, in the Marcy Mill, it is the discharge from the mill. If the Marcy Mill is in closed circuit with a mechanical classifier, then the overflow is the finished product.

INFORMATION FOR INQUIRERS

With the above definitions in mind when writing for information for Marcy Mills, please give the following particulars regarding your problem:

1st. Capacity in dry tons per hour desired.
2nd. Character of material to be crushed with special mention as to hardness, and the ease with which it breaks.
3rd. What is the size to be crushed, and what mesh is required for the finished product.
4th. What metallurgical process follows the finished product, and what is your problem.
5th. If you are using other grinding machinery, please state how it is used, and what are the results.
6th. What form of power is to be used. If electric, state whether ball mills are to be belted or direct connected.
7th. Give a sketch showing the space available for the mill and any other information that will assist in the problem.

BALLS

We have found the "Adamantine" Chrome forged steel ball to be very satisfactory and economical, especially when taking a coarse feed and grinding for concentration and flotation, and we recommend the use of this ball in the Marcy Mills.

However, special cast balls are used successfully in many places when crushing fine feeds, soft materials, and where it is a question of cost.

The diameters, weights and exact proportions of balls to be used in initial and replenishing charges are problems to be worked out in each individual case and depend largely upon the character of the material to be crushed. (The harder and coarser the rock, the larger the balls required.) In general we use as small a ball as will break the coarse pieces of rock. Ordinary cast iron balls will not do for Marcy Mill crushing. There is very little pulp in this mill; there is no soft landing place for the balls, consequently only first-class balls will answer; pebbles would also be ground up quickly in this mill.

APPROXIMATE MARCY MILL CAPACITIES

MEDIUM HARD PORPHYRY ORE (INSPIRATION) TAKING 2½-IN. FEED

Table 1

Size of Mill	Tons 24 Hours, -8 Mesh	Tons 24 Hours, -20 Mesh	Tons 24 Hours, -35 Mesh	Tons 24 Hours, -48 Mesh	Tons 24 Hours, -65 Mesh	Tons 24 Hours, -100 Mesh
No. 32	20	15	12	10	7	4
No. 43	50	38	30	25	18	11
No. 54	90	68	52	45	32	18
No. 64½	300	225	180	150	105	60
No. 75	500	375	300	250	180	100
No. 86	1,000	750	600	500	360	200

For the very hard quartz these capacities should be reduced by one-half; for soft porphyry, like the Nevada Consolidated ores, tonnage could be increased 100%. When the feed is finer than given above, the capacity will be increased somewhat, but not to the extent that one might expect. As an illustration, with medium hard porphyry, as given, if the feed is—say ¼-inch with the fines removed, so that 90% is plus 48, and if you crush this feed to pass 48 mesh, the capacity of the above tables will be increased about 10%. The amount of finished product in the feed has much to do with the capacity of the mill. Samples should be sent to our Engineering Department for their examination and advice. Care must be used in estimating tonnages. There is a big difference in capacity whether you crush through 48 or 5% plus 48. Be accurate in discussing screen sizes.

BEST OPERATING CONDITION

In order to operate the Marcy Mill at its best capacity and efficiency, it should be so run that the pulp is low within the mill, with the proper consistency, ball charge and feed, the mill should be noisy. To maintain this condition, the mill should be given a constant rate of feed and water. We advise with motor drives to connect the motor with an ammeter, located in full view of the Ball Mill Operator. Then adjust the feed so as to maintain a constant amperage; if the ammeter drops in amperage, then the mill is overloaded. With this arrangement, many additional tons can be crushed per shift, over indifferent operation, without additional cost in power, steel, or labor.

GENERAL SPECIFICATIONS FOR MARCY BALL MILLS

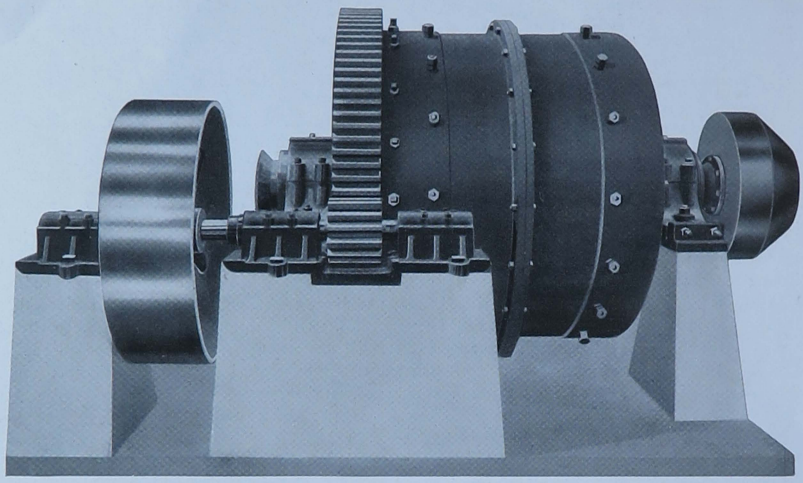


FIG. 9

SHELL.—The shells are semi-steel, made in two sections, of heavy design, cast from a special mixture. They are secured together with a heavy connecting flange, the face and edge of which are accurately machined, made true and parallel with the trunnion seat. The flange is accurately drilled for the connecting bolts and is turned with a tongue and groove to insure a tight joint and to carry the shearing effect of the load. The heads are securely reinforced by heavy radial ribs. These ribs terminate in a thick section at the center of the head which provides a suitable seat, which is turned and counter bored for the trunnion flange. All bolt holes are spot-faced to insure perfect seats for the nuts and to prevent leakage. The shells are provided with extra thickness of material in circular bands in line with the liner bolt holes to compensate for the metal taken out for these bolts.

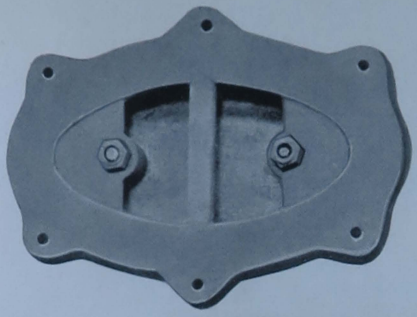


FIG. 10

MANHOLES—Manholes are placed in the feed heads of the Marcy Mills and are of sufficient size for taking in and out of all liners and grates. Each manhole is fitted with a heavy cast cover, to which is attached a renewable liner, and the cover is also provided with suitable handles to facilitate the handling of same. The flanges of the covers are grooved and fitted with heavy circular gaskets to prevent leakage.

TRUNNIONS.—The trunnions are of removable type on all mills except the Nos. 32 and 43. All trunnions have a large bearing surface so as to avoid all possibility of heating in operation. They are provided with large central openings, permitting the feeding and discharging of the mills to their maximum capacity. The removable trunnions are made with machined, tongued and grooved flanges, and are bolted to the heads by means of a sufficient number of stud bolts. The outside ends of the trunnions are also flanged to fit the feed and discharge end castings.

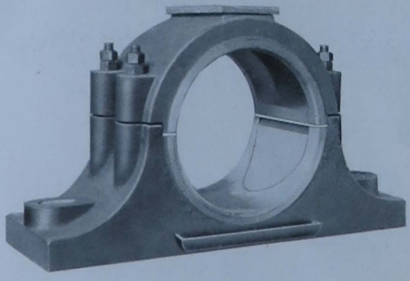


FIG. 11

TRUNNION BEARINGS.—The shell is carried on trunnions at each end which run in rigid bearings of heavy design. The lower half of these bearings are lined with high-grade babbitt, peened and bored to size to fit the trunnions. The bearing caps are cored out to form a large chamber for the reception of waste for the purpose of continuous lubrication, and are bored to prevent the entrance of grit. The bearing base is planed to fit the base plate.

FIG. 12

GEARS.—All belt-driven mills are equipped with split spur gears, which are cast in blank from gear iron and have cut teeth. The entire flange and face are machined, making the gear reversible, so that both sides of the teeth may be worn. The flange ring is drilled and bored to template to fit the turned seat on mill head.

PINION.—The pinions are forged steel, with cut teeth, and are entirely machined.

PINION SHAFT.—The spur pinion is mounted on a cold rolled steel pinion shaft, complete with collars and key-seated for pulley.

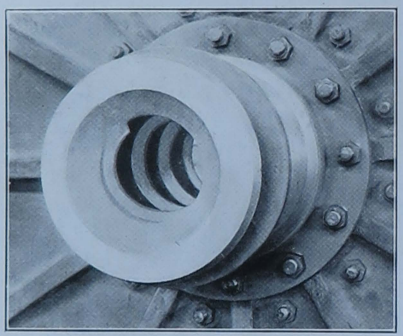


FIG. 13

TRUNNION LINERS.—Both trunnions are lined with renewable liners to prevent the feed and discharge from destroying them from the inside. Each feed end trunnion liner is provided with a high worm or screw of proper pitch to successfully and rapidly carry the material through the trunnion into the mill. This applies only to the 6 ft., 7 ft. and 8 ft. mills. On the larger mills this liner is provided with a turned bevelled seat immediately behind the flange, by which it is bolted to the trunnion. This seat fits into a corresponding seat turned in the trunnion. Also, the end of this liner, which is bolted to the feeder, is provided with a similar tapered seat to prevent the shearing of the bolts connecting them to the feeders. The discharge trunnion is lined with a heavy, smooth liner having a cast bell to successfully conduct the discharge into the launder leading away from the mill with no back drip.

FIG. 14

LINERS.—The feed end and shell liners are of very heavy section made of Chrome or Manganese steel and varying from 3-inch to 5-inch in thickness. The liners are sufficient to last from six to nine months. All lining sections are of a size that will pass through the manholes.

BASE PLATES.—The trunnion bearings are supported on heavy sole plates, which are securely bolted to the foundation. One trunnion sole plate is attached to the pinion shaft sole plate, thus making a true and rigid connection between the gear and pinion. To these sole plates are attached heavy lugs, with adjusting screws for adjusting the bearings, to obtain perfect mesh between the gear and pinion.

FEEDERS.—We have several designs of feeder which can be furnished with the Marcy Mill, the selection of which depends upon the arrangement of installation, the size of feed and work to be done. In making inquiries for mills, kindly state the conditions, so we may recommend the type of feeder which we think would be satisfactory.

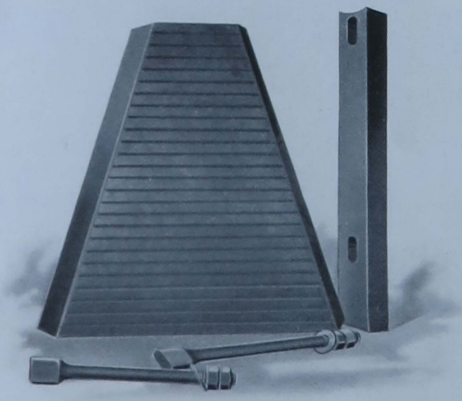


FIG. 15

DISCHARGE. — The discharge end is provided with the Marcy patent grates, made with openings $\frac{3}{32}$-inch, $\frac{1}{8}$-inch, $\frac{3}{16}$-inch and $\frac{1}{4}$-inch, depending upon what product is desired. These grates are made of special high carbon Chrome steel, tempered, welded and machined. The bars are 3-inch and $3\frac{1}{2}$-inch in thickness and are held securely in place.

PINION SHAFT BEARINGS.—The pinion shaft bearings for all the large mills are the double rigid, ring oil type, and are cast solid with a

heavy pinion shaft sole plate, thus assuring perfect alignment and rigidity. They are provided with removable cast iron babbitted bushings. These bearings are not adjusted laterally, but the adjustment for the gears is made by moving the trunnion bearings, for which purpose heavy set-screws are provided. Each bearing is equipped with a glass oil depth gauge. The pinion shaft bearings for the Nos. 43 and 32 Mills are of the rigid angle type and adjustable on the sole plate.

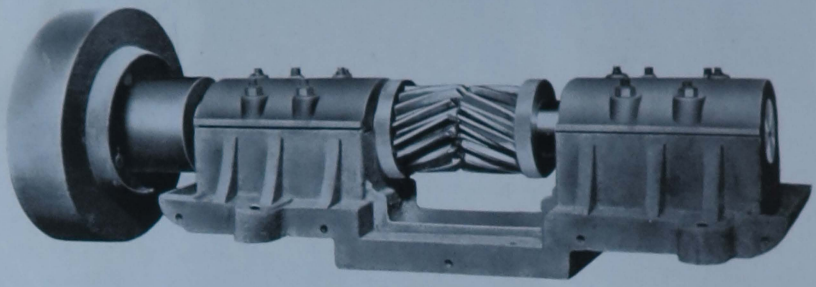


FIG. 16

OUTBOARD BEARINGS.—All of the belt-driven mills, excepting the Nos. 43 and 32, are provided with an outboard bearing of the same type as the pinion shaft bearings.

PULLEYS.—The belt-driven mills are fitted with cast iron double-belt pulleys, turned and balanced, and of proper size to safely start and operate the machine. (For size of pulleys, see Dimension Sheet.)

BOLTS.—The liners and grates are held in by large bolts made with special heads, and are all equipped with lock-nuts and washers.

WRENCHES.—One set of wrenches are furnished for the liner bolts.

BALLS.—No balls are furnished with the mill.

FOUNDATION BOLTS.—No foundation bolts are furnished.

BLUE-PRINTS AND INSTRUCTIONS.—All necessary blue-prints and instructions are furnished by us for the erection and operation of the mill.

SOME OF THE PUBLISHED ARTICLES WITH REFERENCE TO THE MARCY MILL

Mine and Mill Plant of the Inspiration Consolidated Copper Co.,
By H. Kenyon Burch, September, 1916, Bulletin A. I. of M. Eng.
History of the Flotation Process,
By Rudolf Gahl, September, 1916, Bulletin A. I. of M. Eng.
Notes on Ball Milling,
By F. E. Marcy, March 15, 1917, Metallurgical and Chemical Engineering.
Recent Test of Ball Mill Crushing,
By C. T. VanWinkle, January, 1918, Bulletin A. I. of M. Eng.

MARCY MILL SIZES

Table 2

Size No.	Usual Weight Ball Charge	H. P. to Run	Size Motor Recom'd, H.P.	Approximate Shipping Weight, Complete, Without Balls		Cubical Measurements, Packed Ocean Shipment
				Belt	Direct	
32	1,000	6–8	10	7,500	.....	.....
43	2,500	15–20	20	14,500	.....	225
54	4,000	30–40	40	24,000	.....	260
64½	7,000	50–75	75	43,000	43,000	600
75	18.000	100–150	150	70,000	67,000	650
86	30,000	150–225	225	100,000	98,000	700

STOCK

We carry in stock mills of all sizes and sufficient in number to meet the market requirements and demands.

HEAVIEST PIECES OF MARCY MILLS

Table 3

No. 32	Shell	1,100 lbs.
No. 43	Discharge Head	2,750 lbs.
	Feed Head	2,500 lbs.
No. 54	Discharge Head	3,700 lbs.
	Feed Head	3,260 lbs.
No. 64½	Discharge Head	6,000 lbs.
	Feed Head	5,400 lbs.
No. 75	Discharge Head	11,000 lbs.
	Feed Head	9,700 lbs.
No. 86	Discharge Head	16,000 lbs.
	Feed Head	14,000 lbs.

BALL LOAD FOR CRUSHING COARSE FEED 1″ TO 3″

Table 4

Diameter of Ball	No. 32 Mill	No. 43 Mill	No. 54 Mill	No. 64½ Mill	No. 75 Mill	No. 86 Mill
3″	100	250	400	600	2,000	3,000
3½″	200	500	800	1,000	3,000	5,000
4″	300	750	1,200	1,900	5,000	10,000
5″	400	1,000	1,600	2,500	8,000	12,000
Total Lbs.	1,000	2,500	4,000	6,000	18,000	30,000

Replace with 5″ balls daily.

BALL LOAD FOR CRUSHING FEED ⅛″ TO ½″

Table 5

Diameter of Ball	No. 32 Mill	No. 43 Mill	No. 54 Mill	No. 64½ Mill	No. 75 Mill	No. 86 Mill
2½″	100	500	1,000	1,500	2,000	4,000
3″	200	500	1,000	1,500	4,000	8,000
3½″	400	900	1,200	2,500	7,000	10,000
4″	300	600	800	1,500	5,000	8,000
Total Lbs.	1,000	2,500	4,000	7,000	18,000	30,000

Replace with 4″ balls daily.

BALL WEIGHTS*

Table 6

Size	Weight per Cubic Feet	Weight per Ball	Number per Net Ton
2″	256 lbs.	1.18 lbs.	1,690
2½″	256 lbs.	2.31 lbs.	860
3″	256 lbs.	3.96 lbs.	505
3½″	256 lbs.	6.34 lbs.	315
4″	256 lbs.	9.48 lbs.	211
4½″	256 lbs.	13.50 lbs.	148
5″	256 lbs.	18.54 lbs.	108
6″	256 lbs.	32. lbs.	63

*From the Chrome Steel Works Catalogue.

HILL FRICTION CLUTCHES, SMITH TYPE

Unless otherwise specified we furnish the Smith Type Hill Friction Clutch, which is the latest design of the well known Hill Type of Friction Clutch.

Table 7

Size of Mill	Speed	Start Load, H.P.	Size of Clutch Pulley	Size of Shaft	Size of Clutch	Space on Shaft
No. 32	215	20	30 x 6½	2 3-16	20	25″
No. 43	229	40	36 x 8½	2 15-16	35	30″
No. 54	232	80	48 x 12½	3 11-16	75	36″
No. 64½	196	150	68 x 17	4 3-16	110	43″
No. 75	161	300	80 x 20	4 15-16	230	48″

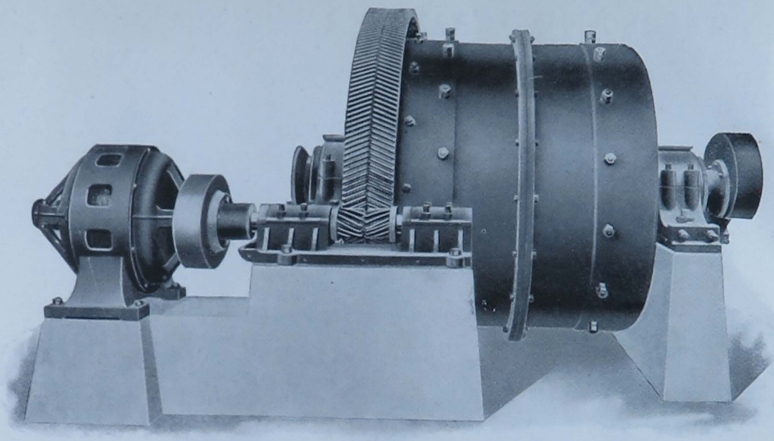


FIG. 17—DIRECT CONNECTED MARCY MILL

METHODS OF DRIVING MARCY MILLS

1. Direct connected motor to pinion shaft by Herringbone Gears.
2. Belted direct to pinion shaft by rigid pulley.
3. Belted direct to pinion shaft by friction clutch pulley.
4. Motor driven by use of Lenix Type Belt drive for short centers.
5. Motor driven by two-gear reduction, allowing the use of higher speed motors and spur gears.

TYPES MARCY MILL-FEEDERS

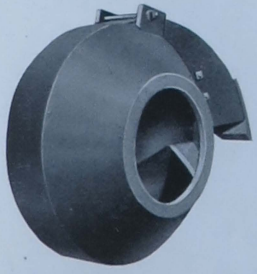


FIG. 18—COMBINATION DRUM AND SCOOP

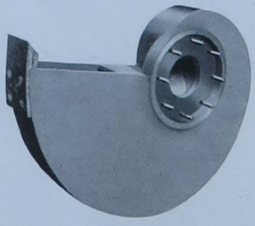


FIG. 19—SINGLE SCOOP

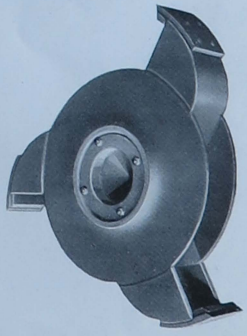


FIG. 20—THREE SCOOP

RADII AND DIAMETERS OF FEEDERS

Table 8

Size of Mill	Single Scoop	Three Scoop	Drum Type	Combination Drum and Scoop
No. 32	14″ Radius	.....	23″ Diam.	.....
No. 43	15″ Radius 23″ Radius	.....	30″ Diam.	23″ Radius
No. 54	15″ Radius 23″ Radius	.....	30″ Diam.	23″ Radius
No. 64½	23″ Radius 34″ Radius	21″ Radius 32″ Radius	36″ Diam.	32″ Radius
No. 75	26″ Radius 36″ Radius	33″ Radius	45″ Diam.	37″ Radius
No. 86	24″ Radius 30″ Radius 36″ Radius 42″ Radius	35″ Radius	54″ Diam.	39″ Radius

It is of great importance that the proper feeder be selected for the work that it is required to do. We have scoop feeders to suit all ore conditions. Careful consideration should be given this subject. In ordering state the hand of the mill as given on pages 25 and 26.

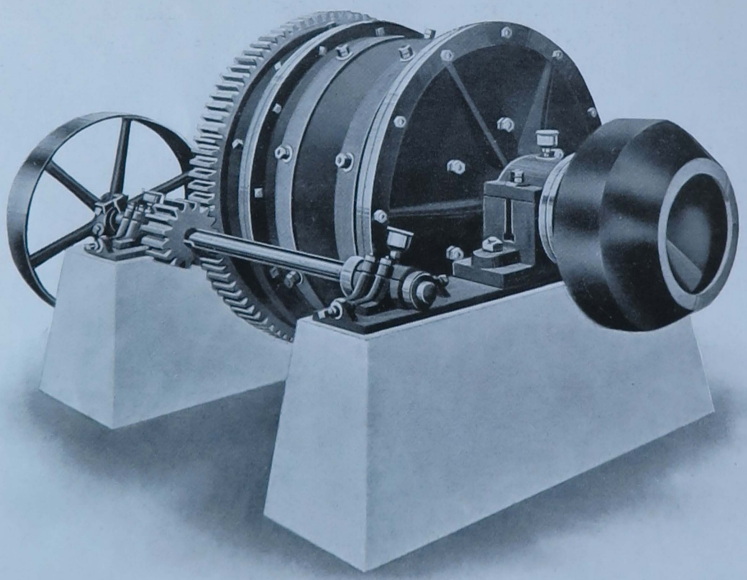


FIG. 21—No. 43 MARCY MILL WITH DRUM TYPE FEEDER

HANDS OF MILLS

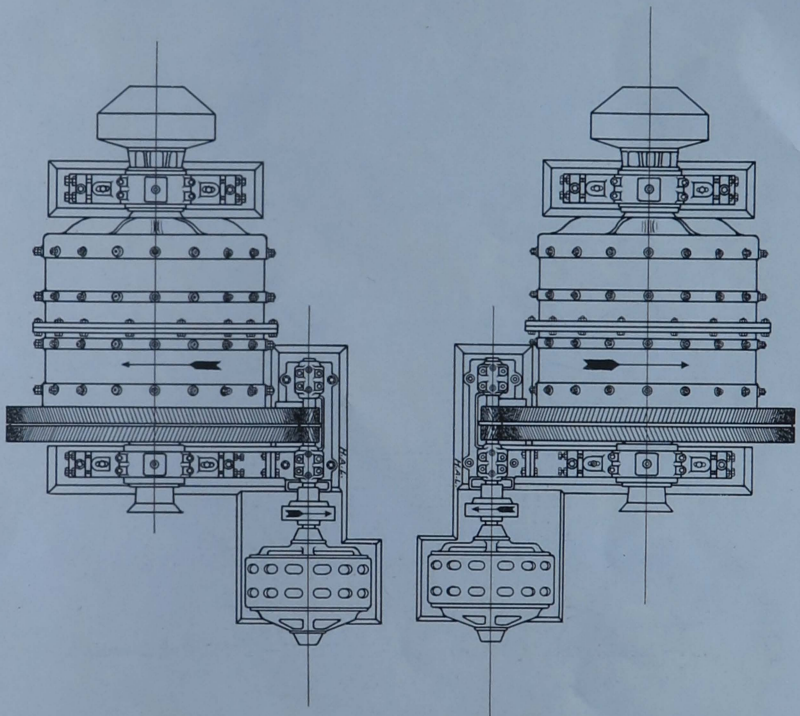


FIG. 22—MOTOR DRIVEN RIGHT HAND

FIG. 23—MOTOR DRIVEN LEFT HAND

The Marcy Mills which are carried in stock are right-hand mills, but they can be furnished either hand desired. Information relative to the hand of the mill should be given in all inquiries and should be clearly stated on all orders.

HANDS OF MILLS

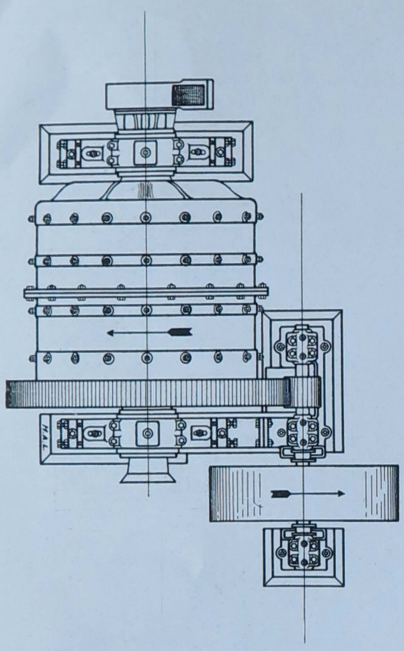


FIG. 24—BELT DRIVEN RIGHT HAND

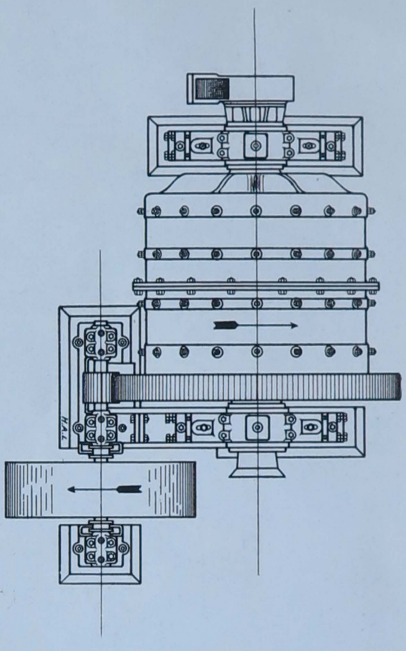
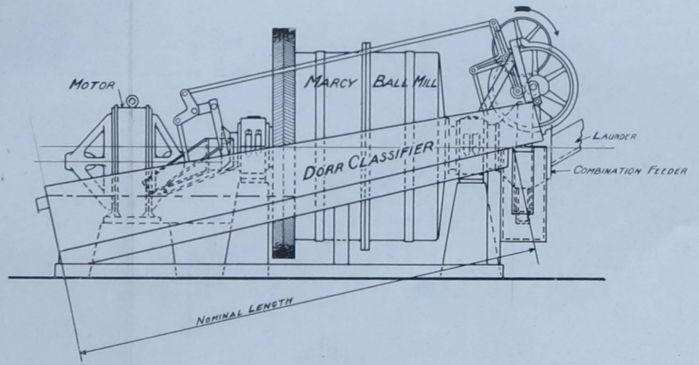


FIG. 25—BELT DRIVEN LEFT HAND

DEFINITION RIGHT-HAND MILL.—When standing at the feed end and looking over the mill toward the discharge end, the mill barrel revolves clock-wise or toward the right, and the pinion shaft is on the left side.

DEFINITION LEFT-HAND MILL.—When standing at the feed end looking over the mill toward the discharge end, the mill barrel revolves counter clock-wise or toward the left, and the pinion shaft is on the right.

Arrangement of the Marcy Ball Mill in Closed Circuit with the Dorr Classifier



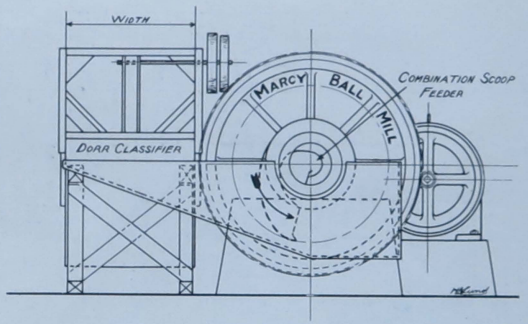
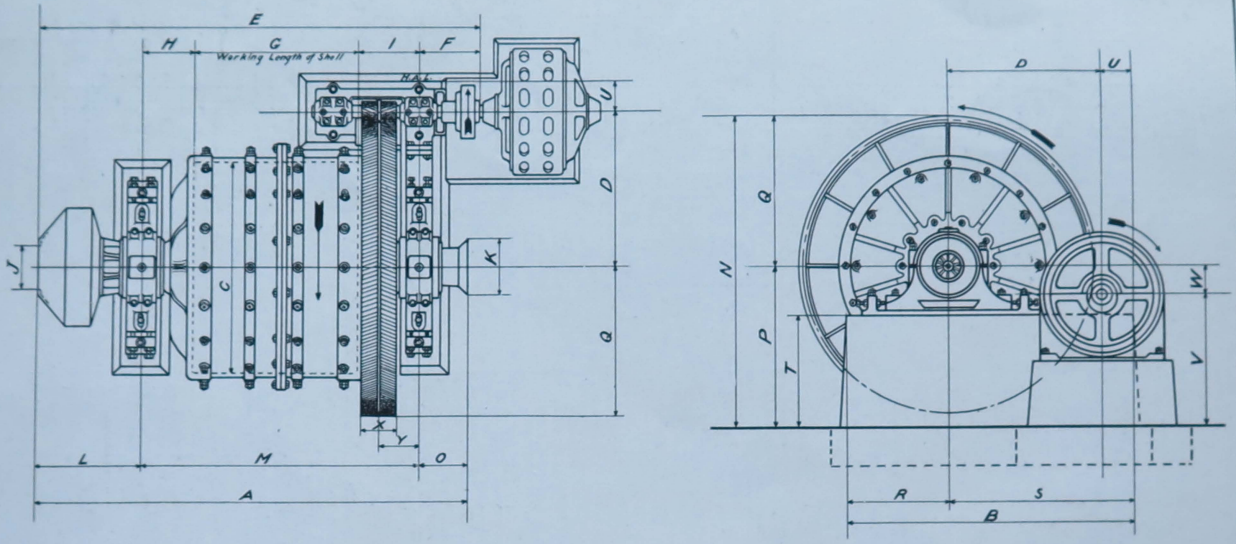


Table of Data for Marcy Ball Mills of Different Sizes.

No. 43 Marcy Ball Mill						No. 54 Marcy Ball Mill						No. 64½ Marcy Ball Mill						No. 86 Marcy Ball Mill					
Simplex Dorr Classifier				Mesh of Product	Tons per 24 Hrs.	Simplex Dorr Classifier				Mesh of Product	Tons per 24 Hrs.	Duplex Dorr Classifier				Mesh of Product	Tons per 24 Hrs.	Duplex Dorr Classifier				Mesh of Product	Tons per 24 Hrs.
Width	Length	Slope per Ft.	Type			Width	Length	Slope per Ft.	Type			Width	Length	Slope per Ft.	Type			Width	Length	Slope per Ft.	Type		
2'-3"	14'-8"	3"	C	20	30	2'-3"	14'-8"	3"	C	20	50	4'-6"	14'-8"	3"	C	20	225	—	—	—	—	20	600
"	"	3"	"	30	27	"	"	3"	"	30	45	"	"	3"	"	30	200	6'-0"	18'-4	3"	D	30	500
"	"	2¾"	"	48	25	"	"	2¾"	"	48	40	"	16'-4"	2¾"	"	48	150	"	21'-8"	2¾"	"	48	400
"	"	2⅝"	"	60	20	"	"	2⅝"	"	60	30	"	18'-0"	2⅝"	"	60	100	"	23'-4"	2⅝"	"	60	250
"	"	2½"	"	100	12	"	"	2½"	"	100	20	"	19'-8"	2½"	"	100	75	6'-0"	25'-0"	2½"	D	100	200

Classifier Speeds		Slope & Speed of Classifiers subject to variation
20 to 48 Mesh	25 Strokes of Rake per Minute	
60 "	20 to 25 " " " " "	
100 "	16 to 20 " " " " "	

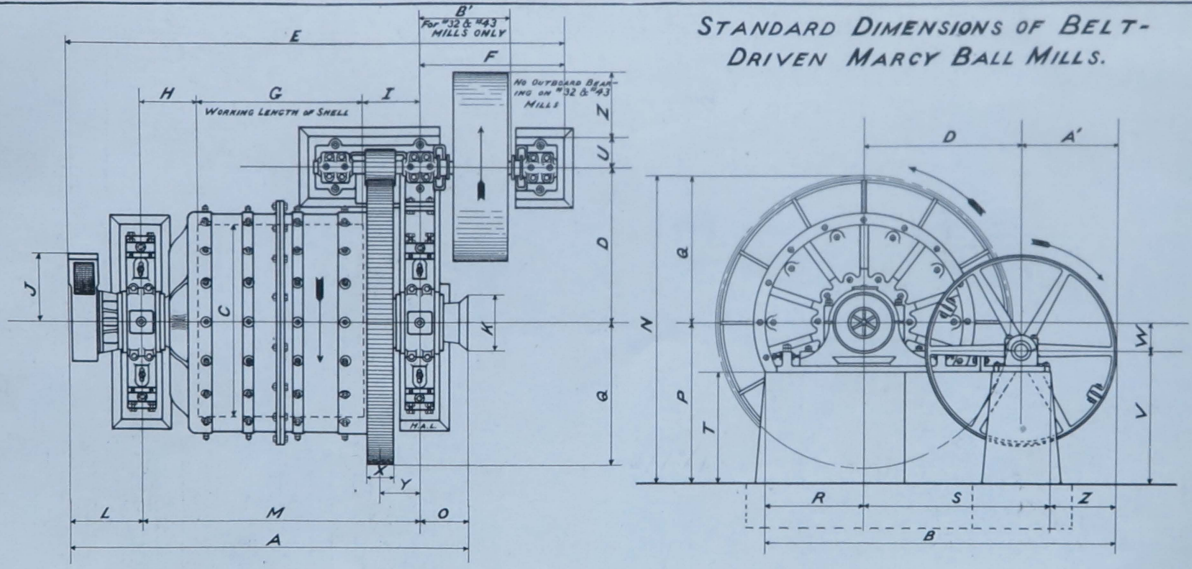
STANDARD DIMENSIONS OF DIRECT CONNECTED MARCY BALL MILLS.



MILL SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N
64½	11'-5⅝"	7'-10⅝"	5'-8"	4'-2⅝"	12'-4"	2'-0"	4'-3½"	1'-5½"	1'-10"	1'-4½"	1'-6"	2'-9"	7'-7"	8'-6"
86	16'-3⅜"	10'-9⅞"	7'-6"	5'-9⅞"	18'-2⅜"	3'-10"	5'-11½"	2'-1"	2'-5½"	1'-8"	2'-4"	3'-10⅜"	10'-6"	11'-7"

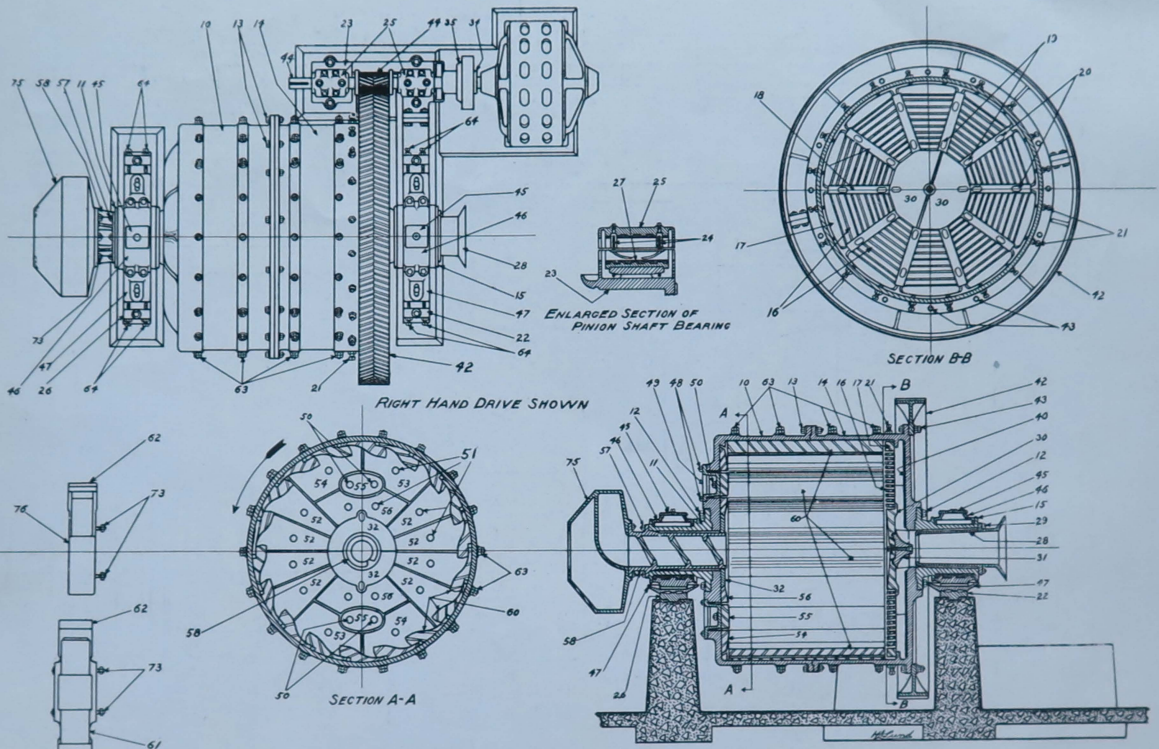
MILL SIZE	O	P	Q	R	S	T	U	V	W	X	Y	MILL R.P.M.	PINION R.P.M.
64½	1'-1⅛"	4'-6"	4'-0"	2'-9"	5'-1⅛"	3'-4"	11½"	3'-11½"	6½"	10"	1'-0½"	25	425
86	1'-11"	6'-0"	5'-7"	3'-10½"	6'-11¼"	4'-2"	1'-1½"	4'-11"	1'-1"	1'-2"	1'-5¾"	22	350

STANDARD DIMENSIONS OF BELT-DRIVEN MARCY BALL MILLS.



MILL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
#32	6'-2⅝"	4'-11"	2'-8¾"	2'-3¼"	—	—	1'-9¾"	11"	1'-4¼"	12" RAD.	1'-1"	1'-6½"	4'-1"	4'-5½"	7¼"	2'-4⅞"
#43	8'-0⅛"	6'-0¼"	3'-6"	2'-10¼"	—	—	2'-11"	1'-1¼"	1'-4¾"	1'-3" "	1'-2"	1'-7⅛"	5'-5"	5'-5¼"	11½"	2'-10⅛"
#54	8'-11⅞"	7'-10¼"	4'-5"	3'-9¾"	11'-5⅛"	3'-4"	3'-10½"	1'-2⅜"	1'-5⅞"	1'-3" "	1'-2"	1'-6⅛"	6'-6¼"	7'-3⅛"	10¾"	3'-10"
#64½	7'-6⅞"	9'-9⅛"	5'-8"	4'-2⅛"	13'-8⅛"	4'-0¾"	4'-3½"	1'-5½"	1'-10"	1'-11" "	1'-6"	2'-0¼"	7'-7"	8'-3⅛"	1'-1⅛"	4'-6"
#86	15'-7½"	13'-3¼"	7'-6"	5'-9¾"	19'-0½"	5'-4½"	6'-0"	2'-0½"	2'-5½"	2'-11" "	2'-3½"	3'-2½"	10'-6"	11'-4¾"	1'-11"	6'-0"

MILL	Q	R	S	T	U	V	W	X	Y	Z	A'	B'	MILL R.P.M.	PINION R.P.M.	PULLEY SIZE
#32	2'-0¾"	1'-4¾"	3'-1¼"	1'-9"	10"	2'-0"	4⅞"	5"	7¼"	5"	1'-3"	11⅜"	35	215	30"X6½"
#43	2'-7"	1'-8"	4'-0"	2'-0"	1'-1¾"	2'-4½"	5¾"	6½"	9½"	4¼"	1'-6"	1'-3"	31	229	36"X8½"
#54	3'-5⅞"	2'-1"	4'-8½"	2'-11¼"	10½"	3'-5¾"	4¼"	7½"	10⅞"	1'-1½"	2'-0"	—	29	232	48"X12½"
#64½	3'-9⅜"	2'-9"	5'-1⅜"	3'-4"	11½"	3'-11½"	6½"	10"	1'-0½"	1'-10½"	2'-10"	—	25	196	60"X16½"
#86	5'-4¾"	3'-10½"	6'-11¼"	4'-2"	1'-1½"	4'-11"	1'-1"	14"	1'-6½"	2'-5½"	3'-7"	—	22	196	86"X24½"



PLAN AND SECTIONS OF MARCY MILL, R.H.

SEE OPPOSITE PAGE FOR SEPERATE PARTS

THESE PARTS ARE FOR THE DIRECT DRIVE MARCY BALL MILL SHOWN ABOVE

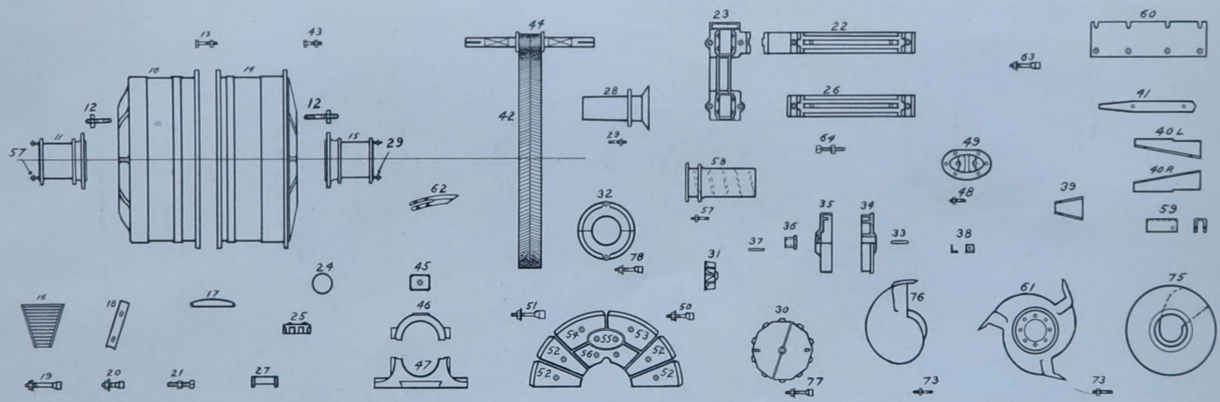
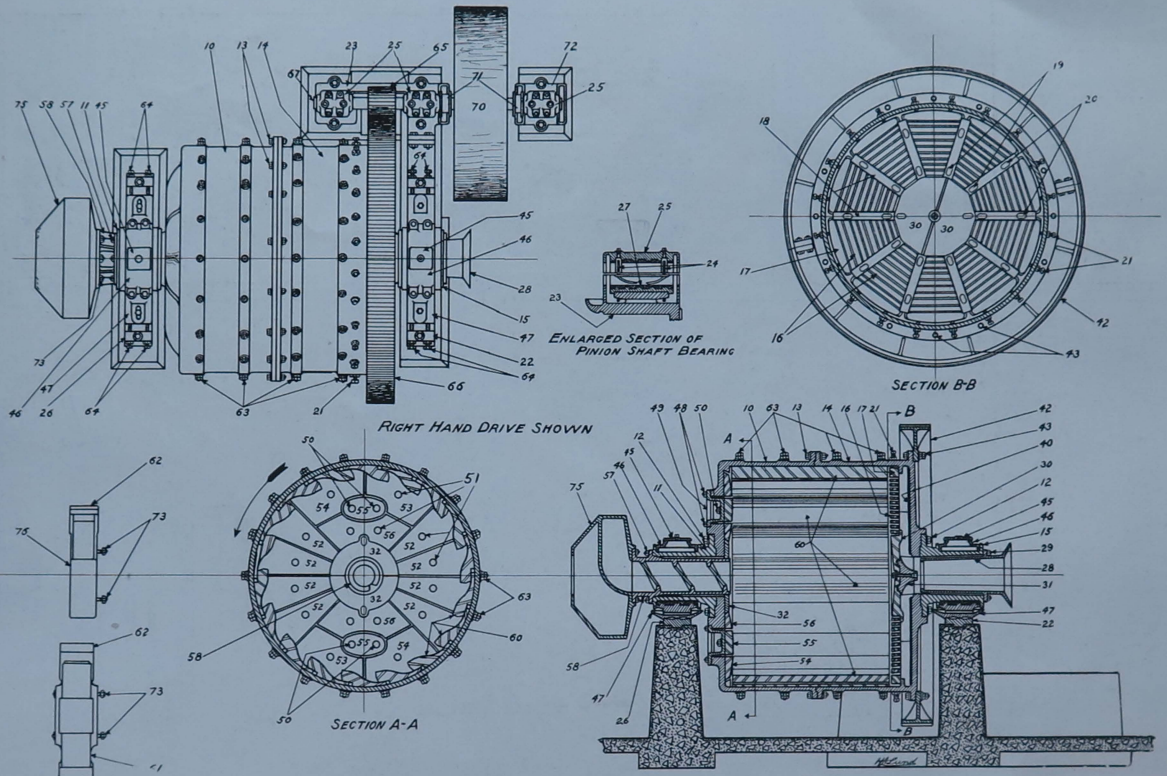


TABLE OF PARTS

No.	Pcs.	Material	Description
10	1	Semi-Steel	Feed Head
11	1	Cast-Iron	Feed End Trunnion
12	32	Steel	Trunnion Studs, for Both Ends
13	24	" "	Shell Connecting Bolts
14	1	Semi-Steel	Discharge Head
15	1	Cast-Iron	Discharge End Trunnion
16	10 Sec.	Chrome St.	Grate Bars in Sections
17	10	Cast-Iron	End Clamp Bars
18	10	Mang. Steel	Side Clamp Bars
19	10	Norway I.	Long Side Clamp Bar Bolts
20	10	" "	Short " " "
21	20	Steel	Grate Ajusting Set Screws
22	1	Cast-Iron	Trunnion Sole Plate, Discharge End
23 RH	1	" "	Pinion Shaft Sole Plate
23 LH	1	" "	" " " "
24	4	Steel	Oil Ring for Pinion Shaft Bearing
25	2	Cast-Iron	Pinion Shaft Cap
26	1	" "	Trunnion Sole Plate, Feed End
27	2	" "	Pinion Shaft Bushing
28	1	" "	Trunnion Liner, Discharge End
29	8	Steel	" " " End Studs
30	1	Cast-Steel	Center Discharge Liner
31	1	" "	" " " Cone
32	1	" "	Feed End Center Liner
33	1	Steel	Key for Motor Half of Coupling
34	1	Cast-Iron	Motor Half of Coupling
35	1	" "	Mill Half of Coupling
36	1	" "	Coupling Bushing for Mill Half
37	1	Steel	Key for " " " "
38	20	"	Angle for Discharge End
39	10	"	Discharge End Liners
40 RH	10	"	" " "
40 LH	10	"	" " "
41	10	"	Front Wearing Plate
42	1	Cast-Steel	Herringbone Gear
43	24	Steel	" " " Bolts
44	1	"	" " Pinion & Shaft
45	2	Cast-Iron	Trunnion Bearing Cap Cover
46	2	" "	" " Cap
47	2	" "	Trunnion Bearing
48	12	Steel	Manhole Studs
49	2	Cast-Steel	" " Covers
50	4	Norway-Iron	Manhole Liner Bolts
51	16	" "	Feed End Liner Bolts
52	8	Steel	" " " Liner
53	2	"	" " "
54	2	"	" " "
55	2	"	Manhole Liner
56	2	"	Feed End Liner
57	8	"	Trunnion Liner Studs, Feed End
58 RH	1	Cast-Iron	" " Feed End
58 LH	1	" "	" " " "
59	10	Steel	Box Liner, Discharge End
60	18	"	Breast Liners
61	1	Cast-Iron	Three-Scoop Feeder
62	3	Steel	Scoop-Feeder Lips
63	72	Norway-I.	Breast Liner Bolts
64	8	Steel	Bearing Ajusting Set Screws
73	8	"	Stud Bolts for Feeders
75 RH	1	Cast-Iron	Drum Feeder
75 LH	1	" "	" "
76	1	" "	Single Scoop Feeder
77	2	Norway-I.	Center Discharge Liner Bolts
78	2	" "	Feed End Center Liner Bolts



PLAN AND SECTIONS OF MARCY MILL, R.H.

SEE OPPOSITE PAGE FOR SEPERATE PARTS

THESE PARTS ARE FOR THE BELT DRIVE MARCY BALL MILL SHOWN ABOVE

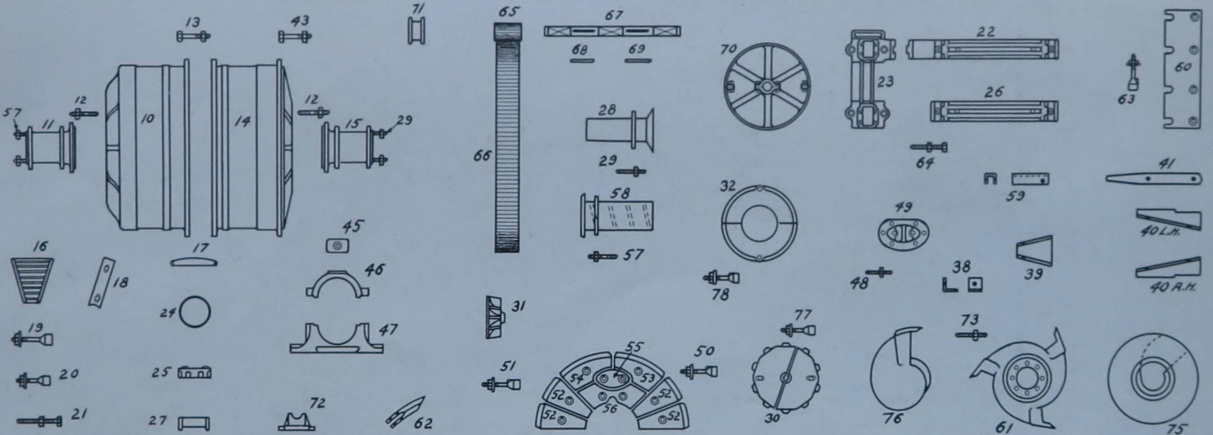


TABLE OF PARTS

No.	Pcs.	MATERIAL	DESCRIPTION	No.	Pcs.	MATERIAL	DESCRIPTION	No.	Pcs.	MATERIAL	DESCRIPTION
10	1	Semi-Steel	Feed Head	31	1	Cast Steel	Center Discharge Cone	58 L.H.	10	Cast Iron	Trunnion Liner, Feed End
11	1	Cast Iron	Feed End Trunnion	32	1	" "	Feed End Center Liner	59	10	Steel	Box Liner, Discharge End
12	32	Steel	Trunnion Studs, Feed & Discharge Ends	38	20	Steel	Angle for Discharge Liners	60	18	"	Breast Liner
13	24	"	Shell Connecting Bolts	39	10	"	Discharge End Liners	61	1	Cast Iron	Three Scoop Feeder
14	1	Semi-Steel	Discharge Head	40 R.H.	10	"	" " "	62	3	Steel	Scoop Feeder Lips
15	1	Cast Iron	Discharge End Trunnion	40 L.H.	10	"	" " "	63	72	Norway Iron	Breast Liner Bolts
16	10 Sec	Chrome St.	Grate Bars	41	10	"	Front Wearing Plate	64	8	Steel	Bearing Adjustment Set Screws
17	10	Cast Iron	End Clamp Bar	43	24	"	Gear Bolts	65	1	"	Pinion
18	10	Manz. Steel	Side " "	45	2	Cast Iron	Trunnion Bearing Cap Cover	66	1	"	Spur Gear
19	10	Norway Iron	Long Side Clamp Bar Bolts	46	2	" "	Trunnion Bearing Cap	67	1	"	Pinion Shaft
20	10	" "	Short " " " "	47	2	" "	Trunnion Bearing	68	1	"	Key for Pinion
21	20	Steel	Grate Adjusting Set Screws	48	12	Steel	Manhole Studs	69	1	"	Key for Pulley
22	1	Cast Iron	Trunnion Sole Plate Discharge End	49	2	Cast Steel	" Cover	70	1	Cast Iron	Pulley
23 R.H.	1	" "	Pinion Shaft Sole Plate	50	4	Norway Iron	" Liner Bolts	71	2	" "	Set Collars
23 L.H.	1	" "	" " " "	51	16	" "	Feed End Liner Bolts	72	1	" "	Out-board Bearing Base
24	6	Steel	Oil Ring for Pinion Shaft Bearing	52	8	Steel	Feed End Liners	73	8	Steel	Studs for Feeders
25	3	Cast Iron	Pinion Shaft Bearing Cap	53	2	"	" " "	75 R.H.	1	Cast Iron	Drum Feeder
26	1	" "	Trunnion Sole Plate, Feed End	54	2	"	" " "	75 L.H.	1	" "	" "
27	3	" "	Pinion Shaft Bushing	55	2	"	Manhole Liner	76	1	" "	Single Scoop Feeder
28	1	" "	Trunnion Liner, Discharge End	56	2	"	Feed End Liner	77	2	Norway Iron	Center Discharge Liner Bolts
29	8	Steel	Trunnion Liner Studs " "	57	8	"	Trunnion Liner Studs, Feed End	78	2	" "	Feed End Center " "
30	1	Cast Steel	Center Discharge Liner	58 R.H.	1	Cast Iron	Trunnion Liner, Feed End				

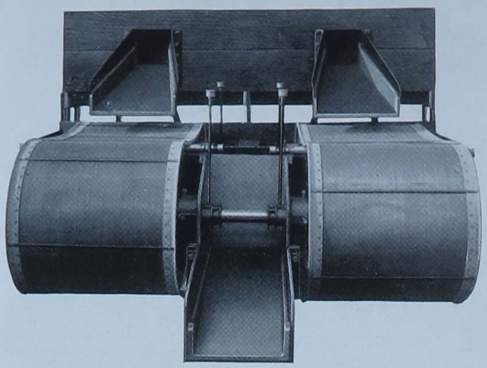
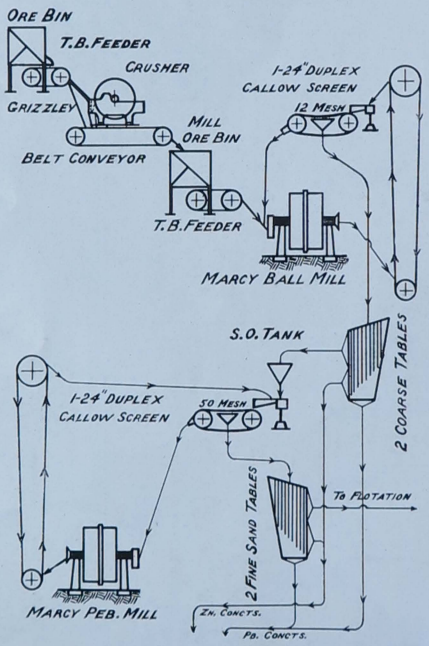
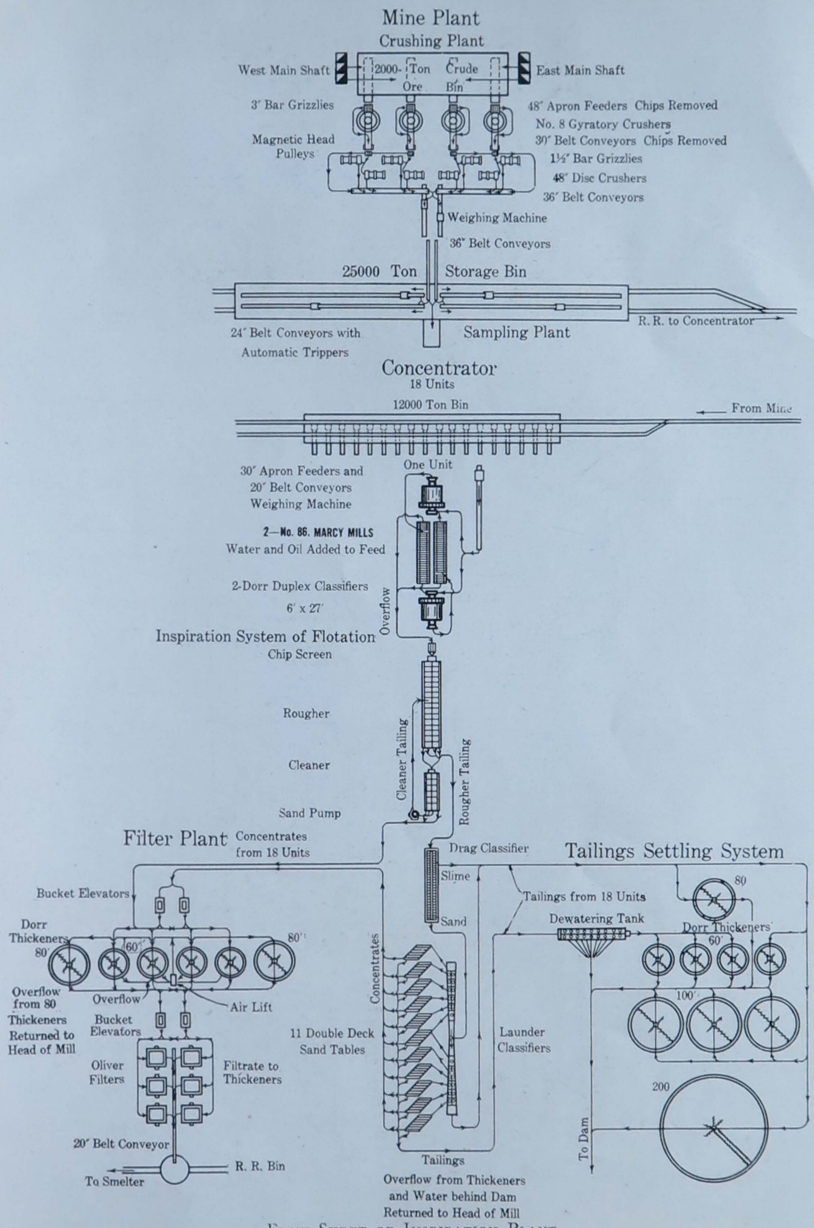


FIG. 26—CALLOW SCREEN

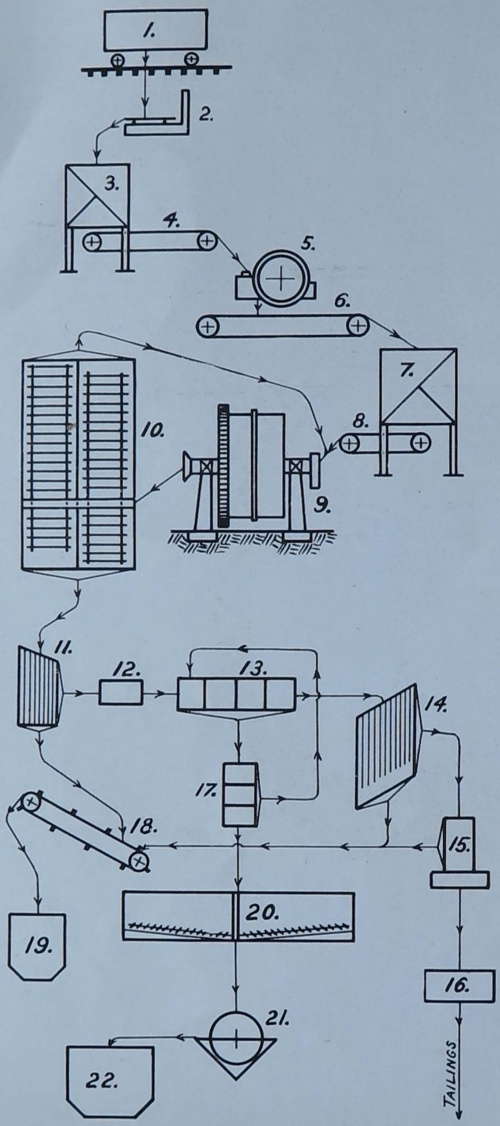
We have found the Callow Screen useful and satisfactory in many cases where screen sizing is required. These screens are built to give a finished product of from 10- to 40-mesh.



FLOW SHEET SHOWING THE USE OF CALLOW SCREENS IN CONJUNCTION WITH TWO-STAGE CRUSHING, "ROUGHING" AND FLOTATION, WITH TWO-MINERAL SEPARATION



FLOW SHEET OF INSPIRATION PLANT



COARSE CRUSHING DEP'T.

1. MINE CARS, CAPACITY 2500 LBS.
2. FAIRBANKS SCALES.
3. CRUDE ORE BIN, CAP. 500 TONS.
4. CONVEYOR, 24-INCH BELT.
5. CRUSHER, 10" BY 20" BLAKE.
6. CONVEYOR, 18-INCH BELT.
7. FINE-ORE BIN, CAP. 200 TONS.

FINE GRINDNG DEP'T.

8. TWO BELT FEEDERS.
9. TWO NO. 6½ MARCY MILLS.
10. DORR CLASSIFIER, 6' BY 22'

TABLE & FLOTATION DEP'T.

11. TWO ROUGHING TABLES.
12. ELEVATOR
13. FLOTATION MACHINE.
14. THREE DOUBLE-DECK DEISTERS.
15. LEWIS TAILING MACHINE.

CONCENTRATE DEP'T.

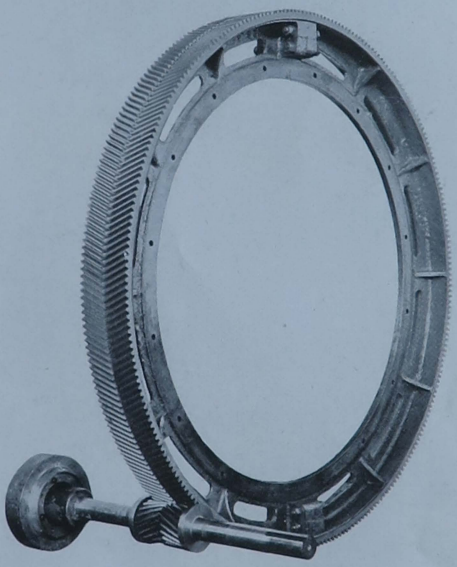
16. SCOBY SAMPLER.
17. CLEANER CELL.
18. DRAG BELT.
19. COARSE CONCENTRATE BIN.
20. TWO DORR THICKENERS, 6' BY 30'.
21. THREE OLIVER FILTERS, 4' BY 5'.
22. CONCENTRATE BIN.

FLOW SHEET STODDARD MINING CO.'S PLANT
CAPACITY 300 TONS

No. 75 MARCY MILL

The Marcy Mill was originally offered in five sizes as described on the previous pages. These sizes of mills have proven successful and have conclusively demonstrated that ball grinding is efficient. The result is a greater demand for this machine.

To meet the requirements for a mill, having a capacity between the No. 64½ and the No. 86 Mill, we have developed a new mill, namely No. 75, which is mentioned in the tables of this bulletin. With the addition of this mill to our list of sizes, we feel that we can meet every demand for capacity.



TYPE OF HERRINGBONE GEARS USED ON MARCY MILLS

MASSCO SERVICE
MINE
MILL
SMELTER
MASSCO SERVICE HAS MADE IT unnecessary for you to "take a chance" in buying equipment or supplies.
MASSCO SERVICE is a giant stretching out his hand to the whole Western Hemisphere. Hardly a requirement for the work of mining, milling, assaying, or smelting that it cannot promptly supply.
MASSCO SERVICE has furnished equipment to plants from Alaska to Chile and from the Golden Gate to Cuba. These products are shipped everywhere. WHY?
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ELECTRICAL APPARATUS · GENERAL MINING MACHINERY · MILL EQUIPMENT.....

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SMITH BROOKS
PRESS

ONE EASY STEP